Introduction

Cigarette smoking by employees results in increased expenses for employers. Smokers use the health care system up to 50 percent more than nonsmokers (Fielding 1984); this means higher health insurance costs for companies. Studies have reported higher rates of work-related accidents, disability reimbursement payments, and absenteeism among employees who smoke than among those who do not (Terry 1971). Although it is difficult to assess exact dollar amounts because of the variety of circumstances and assumptions involved (Warner 1983), estimates of excess annual costs to employers per smoking employee generally run from $200 to $500 (Luce and Schweitzer 1978; Kristein 1982). Costs attributable to smoking among employees in the high risk occupations discussed in this Report are likely to be considerably higher than these overall estimates.

These data, as well as consideration for the welfare of their employees, have led a number of businesses to establish workplace antismoking programs. Because of the magnitude of the health effects of smoking and the benefits of cessation, smoking cessation programs are likely to yield a higher return on investment than worksite health promotion programs targeting other risk factors such as obesity and lack of exercise (Fielding 1984). Surveys reveal that 11 to 15 percent of American businesses provide smoking reduction programs and many more are considering such programs (Dartnell Inst. 1977; NICSH 1980). In response to the recommendations of a panel of experts concerning priorities for health promotion activities, the Health Insurance Association of America has established a smoking reduction program that is available to its members (Fielding 1984). From one-third to one-half of the large organizations have designated no-smoking areas (Dartnell Inst. 1977; NICSH 1980).

A great variety of worksite smoking-modification approaches have been devised, including monetary incentives and contests for not smoking, distribution of self-help materials, physician messages and health education lectures on the adverse effects of smoking, and stop-smoking clinics (Chesney and Feuerstein 1979; Danaher 1980; Klesges and Glasgow 1985; Orleans and Shipley 1982). Stop-smoking sessions have been led by coworkers, volunteers from health organizations, commercial cessation consultants, and health professionals. Ongoing multiple risk factor intervention programs, either for the entire workforce or for individuals at especially high risk of developing cardiovascular disease, have been offered. The purpose of this chapter is to critically review the literature on such programs. First, however, it is helpful to consider both the potential advantages and the possible disadvantages of worksite smoking modification programs versus the more traditional, clinic-based programs.

The potential advantages of worksite-based smoking modification programs can be considered from the perspective of employees, employers, and public health researchers. For employees, the primary potential advantages appear to be increased convenience (particularly if the program is held during work hours), reduced expenditure if the company pays all or part of the program fee, and the opportunity to participate with friends and coworkers rather than a group of strangers. For the employer, potential benefits include increased worker productivity, better employee morale, and better employee and public relations from health promotion efforts. The potential monetary savings from reduced absenteeism and medical costs are also appealing.

For public health researchers, worksite programs offer the advantages of a much larger number (and possibly different types) of smokers involved in efforts to quit than would otherwise be the case, greater ease in obtaining long-term followup data, and the opportunity to provide sustained or ongoing programs rather than one-time offerings. In worksite programs, treatment is conducted in the environment in which participants spend a large portion of their day, which should facilitate generalization of treatment effects and potentially lead to the establishment of nonsmoking norms. Possibly the greatest potential resource available in worksite programs from all three perspectives is the additional incentive and motivational components that can be brought to bear through both monetary and social support manipulations.

It is important to realize, however, that these potential benefits do not occur automatically (Klesges and Glasgow 1985), and that they may be offset by possible disadvantages of worksite smoking modification programs. From an employee perspective, participation may interfere with work activities or be outwardly condoned, but not supported, by a supervisor. Meetings may be held at inconvenient times or in inconvenient locations. If promotional activities are not handled appropriately, workers may feel coerced to participate. From an employer's perspective, there are the direct costs of the program, such as advertising, counselor time, and materials, as well as indirect costs, such as time off work for employees to participate. Sponsoring an antismoking program can also create employee relations problems. Nonsmoking employees may resent the time off work available to smokers and may demand that their own participation in health promotion programs be subsidized. The critical issue here may be company norms, whether time off is consistent with previous company practice regarding other programs for employee benefit. In organizations in which workers are exposed to hazardous substances such as asbestos, unions may view smoking cessation programs as attempts by management to absolve them-

selves of responsibility for occupationally related disabilities (Ellis 1980).

There are also problems from the perspective of public health researchers in conducting programs in the workplace. Most of these potential disadvantages result from a reduced degree of control over variables that can influence outcome. For example, company program planners (organizational steering committee) might decide to conduct additional stop-smoking activities (e.g., changes in company smoking policies, added incentives for not smoking, participation in other health promotion activities, a contest with a rival business) that are not part of the study design. Finally, some participants may take part solely as a way of getting out of work rather than from a desire to change their smoking behavior.

Criteria for Evaluating Worksite Programs

The criteria for evaluating program effects are considered under three general headings: changes in participants' smoking behavior, effects on smoking and health-related variables for all employees in the organization, and "secondary" effects of a program on nonhealth variables of concern to employers. Most reports on worksite-based programs assess only one or two of these areas.

Changes in Participants' Smoking Behavior

The same considerations that apply to the measurement of adult smoking behavior in clinic settings apply also to worksite smoking modification programs. Specification of reported smoking data is particularly important. Following a program, there is often a bimodal distribution of smoking rate, with a number of individuals successfully quitting and many nonquitters smoking at close to their baseline rate. Presentation of reductions in the "average" number of cigarettes smoked can therefore be misleading. It is important to separate data about subjects who are abstinent from data about those who are still smoking, albeit at a reduced rate, when reporting either reductions in smoking behavior or biochemical indices of smoking exposure.

It is critical, of course, to have information about the long-term (6 to 12 months minimum) effects of smoking modification programs (Lichtenstein and Brown 1982; McFall 1978). Interest in research in the "dynamics of cessation and relapse" is much more recent (US DHHS 1983, p. 246; Ockene et al. 1982). It is helpful to know, for example, whether a 30 percent long-term abstinence rate resulted from the same 30 percent of participants remaining abstinent throughout the followup period or from 10 percent new quitters, 10 percent previous relapsers, and 10 percent who remained abstinent throughout the assessment periods.

Objective verification of changes in smoking behavior has become the standard for defining smoking behavior. Recent reviews have been conducted of several biochemical measures of smoking status, including carbon monoxide, saliva thiocyanate, and cotinine (Frederiksen and Martin 1979; Leupker et al. 1981; Benowitz 1983; Bliss and O'Connell 1984). Simply having an informant, usually a spouse or coworker, "confirm" a participant's smoking status may not be sufficient corroboration. Such people are not in a position to continuously observe a participant's smoking behavior throughout the day and may be persuaded to falsify their report on the participant's smoking behavior.

Worksitewide Program Effects

The impact of a worksite program may include effects on workers other than those enrolled in the program and effects other than smoking cessation. The localized nature of a worksite program and the repetitive interactions of workers in the program with those who did not participate may produce changes in the attitudes and behaviors of the active workforce that promote smoking cessation and improve employee morale and productivity. For these reasons, one criterion for evaluating worksite programs should be the fraction of the workforce whose smoking behavior is altered in addition to the fraction of the participants who quit. All of these effects are important in evaluating the reported success rate of a program because a very high cessation rate for a program may have little overall impact if only small numbers of employees are willing to participate (Kanzler et al. 1976). Whenever possible, program costs should be reported in addition to data on the effects on smoking patterns of nonparticipating smokers. In the same vein, ongoing worksite programs conducted over a number of years should attempt to document the effects of a smoking modification program on variables such as absenteeism, medical care expenses, and health services utilization.

General Effects

Variables such as employee morale and productivity, commitment to the organization, turnover, and employee–employer relations are important potential secondary effects of a worksite program. Because these issues do not directly concern the topic of smoking and health and have been infrequently assessed, they are not considered in this review. It should be noted, however, that Brownell (1985) makes a convincing case that if the field of worksite health promotion is to prosper, concerted attention needs to be directed toward demonstrating the effects of worksite programs on these organization management issues. He argues that managers may be more interested in such results than in changes in health status.

General Review of Worksite Programs

A large number of worksite smoking control programs have been conducted. Unfortunately, only a small percentage of these programs have been evaluated. The characteristics and results of experimental investigations of occupational smoking control programs that have presented more than anecdotal data are outlined in Tables 1 through 3. Many of these studies have consisted of pretest–posttest or posttest-only evaluations without control conditions and have not reported objective measures to validate self-reports of smoking status. The sample size, type of worksite setting, and reported results of such uncontrolled studies are listed in Table 1. Because of the absence of comparison conditions, the lack of verification of smoking status, and the general sparsity of information about program procedures and treatment effectiveness in these reports, there are a host of alternative explanations of their results. Therefore, they are only briefly summarized.

Uncontrolled Studies

Although programs have been conducted in a variety of worksite settings (Table 1), the majority have been either conducted in companies of small to moderate size with white-collar employees or offered only to supervisory personnel. The number of participants is generally small. Self-reported abstinence rates for these uncontrolled studies ranged from 25 to 90 percent (median, 60 percent) at posttreatment and from 6.5 to 91 percent (median, 33 percent) at 6-month or 1-year followup. These figures, while encouraging, must be interpreted with caution because it is often unclear whether the reported rates have excluded subjects who dropped out of treatment or followup, and because, in several studies, subjects received sizable monetary rewards based upon reports of abstinence that were not corroborated by objective measures of smoking.

Not known is the impact of the programs listed in Table 1 on overall rates of smoking in the worksites in which they were conducted (see Bishop and Fisher 1984). The majority of investigations do not report rates of participation in their programs, but the studies that have reported (other than in very small companies as noted below) have been discouraging. For example, Kanzler and colleagues (1976) found that despite an intensive promotional campaign, only 4 percent of smokers in their workplace began the cessation program. Grove and colleagues (1979) found that of 409 smokers in their worksite, only 101 attended the first meeting, and only 33 (8 percent of the smokers in the workforce) completed treatment. Of these 33 subjects, only 9 were abstinent at 6-month followup. Stachnik and Stoffelmayr (1981), noting these generally low participation rates, stated: "The question of how one can

TABLE 1.—Uncontrolled studies without objective measures of smoking status

Study	Number of subjects, type of worksite	Cessation rate (percent)	
		Posttreatment	Followup (No. months)
Andrews (1983)	965 hospital employees	Not reported	26 (20)
Bauer (1978)	81 Bell Laboratories employees	90	30 (6)
Bishop and Fisher (1984)	10–46 employees in each of six companies	25–60	6.5–33 (12)
Dawley et al. (1984)	15 VA hospital employees and 2 patients	88	50 (6)
Ellis (1980)	Asbestos company employees	Not reported	30 (48)
Grove et al. (1979)	33 Blue Cross employees	33	27 (6)
Heckler (1980)	16 Thomas Lipton, Inc. employees	Not reported	50 (1)
Kanzler et al. (1976)	9 psychiatric institute employees and 21 community members	67	40 (12)
Miller (1981)	33 engine manufacturing company employees	Not reported	55 (12)
Rosen and Lichtenstein (1977)	12 ambulance company employees	58	33 (12) (at work)
Shepard (1980)	26 electronics mfg. company employees	Not reported	35 (48) (at work)
Sorman (1979)	55 Riviera Motors employees	Not reported	31 (12)
Stachnik and Stoffelmayr (1983)	Employees in three companies: bank, manufacturer, and health services	Not reported	80–91 (6)

increase participation in smoking cessation programs should receive the same attention that the more standard question of which cessation technique is most effective has received in the past" (p. 49). The exceptions to these low participation rates are seen in studies in the companies with fewer than 100 employees that have employed incentive procedures (e.g., Rosen and Lichtenstein 1977; Sorman 1979; Shepard 1980; Stachnik and Stoffelmayr 1983).

Controlled Studies

Studies that have included control or comparison conditions are presented in Tables 2 and 3[2]. To emphasize the importance of worksite and participant characteristics, these characteristics as well as data on the public health issues of recruitment strategies employed and on the participation and attrition rates experienced are listed in Table 2. The type of intervention and experimental design employed, short- and long-term cessation rates, and type of biochemical validation of smoking status obtained, if any, are described in Table 3. In this section, a general discussion of the status of the worksite smoking modification literature with emphasis on the characteristics of the most successful programs is followed by a more detailed review and discussion of several important subtopics within the occupational smoking modification field—the role of social support, physician assistance, incentive approaches, employees at particularly high risk for the development of cardiovascular or respiratory disease, multiple risk factor reduction programs, and organizational characteristics that affect program success.

The varied programs conducted have ranged in intensity from a brief physician message (e.g., Li et al. 1984) to ongoing programs involving multiple components over a 4- to 5-year period (e.g., Rose et al. 1980). Recent programs have offered participants a variety of behavior change options. In particular, 7 of the 14 studies outlined in Tables 2 and 3 allowed subjects to select as goals either smoking reduction or abstinence.

The most encouraging finding is that the long-term success rates of the programs reviewed are relatively high. Although initial cessation rates do not appear to differ from those typically produced by community-based smoking clinics, the longer term followup data are more positive if viewed as a percentage of posttreatment cessation outcome. Abstinence rates at 6 to 24 months after a program are approximately 60 to 65 percent of those observed at posttest, in contrast to the 20 to 30 percent figures classically cited for clinic programs (Hunt and Bespalec 1974; McFall 1978). In fact, the *lowest* maintenance rate in the studies summarized in Tables 1 and 3 was 26 percent of the posttest rate, and some studies report followup results equal to or better than posttest (e.g., Malott et al. 1984; Meyer and Henderson 1974; Schlegel et al. 1983). On the other hand, much higher long-term abstinence rates, 50 percent or better of all subjects, have recently been reported from a number of treatment programs (US DHHS 1982), and results from the 22-center Multiple

[2] Stitzer and colleagues at Baltimore City Hospitals have conducted a series of studies with hospital employees to investigate the effects of making monetary incentives contingent upon reductions in carbon monoxide levels (Rand et al. 1984; Stitzer and Bigelow 1982, 1983, in press). These studies have been excluded from the tables because the participants were not asked to produce long-term changes in their smoking behavior, but have simply been paid to participate in laboratory research. Only the Rand group study (1984) has attempted to produce complete cessation; it is included in Tables 2 and 3.

TABLE 2.—Worksite, subject, and procedural characteristics of controlled outcome studies

Study	Size and type of worksite	Participation rate (percent)	Characteristics of participants	Attrition rate (percent)	Recruitment strategies
Abrams et al. (1985)	800-employee medical manufacturing company and 1,600-employee insurance carrier	Not reported (estimated 6)	54 clerical and blue-collar employees	42	Paycheck stuffers, posters, newsletter articles
Glasgow et al. (1984)	600-employee telephone company	Not reported (estimated 18)	25 female, 11 male employees	Not reported	Employee organization sponsorship, newsletter notices, posters
Glasgow et al. (in press)	VA hospital, health care services company, and savings and loan	Not reported	20 female, 9 male employees	7	Brochures, posters, newsletter notices, memos
Klesges et al. (1985)	Four banks and one savings and loan, 115–180 workers each	88 with competition; 53 without ($p < 0.05$)	82 female, 25 male employees	9	Brochures, announcements by bank presidents, time off work for participation; prize to bank with highest participation
Kornitzer, Dramaix et al. (1980)	30 Belgian factories	84 agreed to screening	19,390 male employees, aged 40–59 years; high risk: upper 20 percent of risk distribution	Not reported	Not reported
Li et al. (1984)	Naval shipyard	87	871 male shipyard workers	17	Participation asked at required screening

TABLE 2.—Continued

Study	Size and type of worksite	Participation rate (percent)	Characteristics of participants	Attrition rate (percent)	Recruitment strategies
Malott et al. (1984)	Medical clinic and telephone company	Not reported (estimated 7)	20 female, 4 male employees, primarily clerical and nurses	0	Newsletter notices, brochures distributed by supervisors, recruitment in lunchrooms
Meyer and Henderson (1974)	Varian Corporation; 240 employees, volunteers for risk factor screening (13 percent of workforce)	Not reported	36 employees identified at screening as high risk for cardiovascular disease	0	Invitation to health screening
Nepps (1984)	Johnson & Johnson Corporation	Not reported	36 white-collar employees: 20 women, 16 men	67	Posters, desk drops, company newsletter
Rand et al. (1984)	Large city hospital	Not applicable	18 female employees	Not reported	Advertisements, word of mouth
Rose et al. (1980)	24 large British industrial groups	86 agreed to screening	18,210 male employees, 40–59 years old; high risk: upper 12–15 percent of distribution	6–12	Invitation to health screening exam
Schlegel et al. (1983)	28 Canadian military bases	Not reported	243 armed forces personnel (65 percent male)	Not reported	Posters, news releases
Scott et al. (1983)	Large VA hospital	100	26 nurses (22 women, 4 men)	0 of those continued at VA	Individually approached

TABLE 3.—Design and outcome of controlled worksite smoking modification studies

Study	Program intensity and components	Experimental design	Cessation rate (percent)		Biochemical verification
			Post-treatment	Followup (No. months)	
Abrams et al. (1985)	Basic four-session nicotine-fading cessation program; four-session maintenance treatment	Basic program plus health education (n=18); stress management (n=18); or social support (n=18)	38[1] 33[1] 6[2]	33[1] (3) 27[1] 6[2]	CO
Glasgow et al. (1984)	Seven weekly small group meetings on brand changing and number reduction; goal choices, abstinence or controlled smoking	Gradual reduction (n=12); abrupt reduction (n=13); gradual plus feedback (n=11)	Not reported	33[1] (6) 0[2] 0[2]	CO
Glasgow et al. (in press)	(See Glasgow et al. 1984) Social support with two meetings, installments of manual, and phone calls	Basic treatment program (n=13) vs. basic treatment plus significant other social support (n=16)	54 36	25 (6) 23	CO SCN
Klesges et al. (1985)	(See Glasgow et al. 1984) Competition, with monetary prizes, weekly feedback charts	Quasi-experimental; basic treatment (n=16) vs. basic treatment plus competition (n=91)	31 22	14 (6) 18	CO SCN

TABLE 3.—Continued

Study	Program intensity and components	Experimental design	Cessation rate (percent)		Biochemical verification
			Post-treatment	Followup (No. months)	
Kornitzer, Dramaix et al. (1980)	Multiple risk factor program, written advice and antismoking posters; high risk subjects, semiannual physician counseling and stop-smoking booklet	Treatment (n=7,398) vs. screening only (n=8,824)	Not reported	High risk 19[1] (24) 12[2] Random sample 12.5 12.6	No
Li et al. (1984)	One-session physician advice and stop-smoking pamphlet	3- to 5-minute behavioral counseling (n=215) vs. warning to quit (n=361)	Not reported	8.4[1] (3, 11) 3.6[2]	CO
Malott et al. (1984)	(See Glasgow et al. 1984) Coworker support: partner support manual, buddy system, individualized support behaviors	Basic treatment program (n=12) vs. basic treatment plus coworker social support (n=12)	17 17	27 (6) 17	CO
Meyer and Henderson (1974)	Multiple risk factor program, 9 to 12 meetings; 2- to 3.5-hour behavior modification group meetings with spouses	Behavior modification (n=12) vs. individual counseling (n=10) vs. physician advice alone (n=14)	40 25 0	20 (3) 25 33	No
Nepps (1984)	Nine written self-help modules; minimal therapist contact	Quasi-experimental: minimal contact (n=36) compared with earlier group cessation program	22	14 (6)	CO

TABLE 3.—Continued

Study	Program intensity and components	Experimental design	Cessation rate (percent)		Biochemical verification
			Post-treatment	Followup (No. months)	
Rand et al. (1984)	Monetary incentives for low daily CO levels; 1 week of reducing CO levels and 2 weeks of abstinence	Within-subjects design (n=18): baseline—cutdown—abstinence goals	61	28 (3 wks)	CO
Rose et al. (1980)	Multiple risk factor program: posters and stop-smoking booklets; high risk subjects, four company physician consultations	Treatment (n=9,734) vs. screening only (n=8,476)		High risk 12[1] (5 yrs) 0[2] Others 7[1] 0[2]	No
Schlegel et al. (1983)	6-month program; 160-page workbook; abstinence or reduced smoking goal choice; base personnel were therapists	Full treatment (17 sessions) vs. minimal contact (4 sessions) vs. self-help; crossed with nicotine gum/no nicotine gum	45–68[3] 28–31[3] 6–14[3]	25–38[3] (12) 17–29[3] 7–10[3]	No
Scott et al. (1983)	Brief daily sessions with brand fading, treatment manual, and CO feedback, 3 months; abstinence or reduced smoking goal choice	Treatment (n=16) vs. no treatment (n=10)	56[1] 0[2]	25 (9) 0	CO

NOTE: The sample sizes reflect the number of subjects receiving each treatment condition, which in some instances differs from the total number of subjects initiated into the study (see Table 2). Except for the Kleages and colleagues (1985) and the Li and colleagues (1984) studies, in experiments using between-subjects designs there was random assignment to treatment conditions.

NOTE: CO=carbon monoxide; SCN=saliva thiocyanate.

[1,2] At each assessment point, conditions that were significantly different ($p < 0.05$) are identified by different superscripts.

[3] Results of this factorial study are complex and difficult to summarize with a notation system; see text for clarification (numbers for treatment conditions not reported).

Risk Factor Intervention Trial (MRFIT) study showed that long-term abstinence rates actually rose from 1-year to 6-year followup under both intervention and control conditions (US DHHS 1983). These results again indicate the need to separate point prevalence of nonsmoking rates from continuous abstinence rates. Unfortunately, data are seldom presented in terms of survival curves (e.g., Curry et al., in press) or in a manner that permits assessment of the consistency in smoking status over time.

These high followup rates suggest that the worksite may offer more than a convenient location for cessation interventions, and that interactions or changes in attitudes or behaviors in the worksite may be important determinants of the successful maintenance of abstinence. Although there are several potential explanations for these relatively good maintenance data, the most obvious is the ongoing contact that coworkers have with each other during the followup period. Consistent with this hypothesis, the clinic-based smoking cessation program in the MRFIT study, which produced one of the most impressive maintenance rates of any study (Hughes et al. 1981; Ockene et al. 1982), involved ongoing contact over several years. Even if coworkers are not highly supportive of each other, they may come to provide no-smoking cues for other participants.

It is important to note that people involved in many of the worksite studies described here are both self-selected and self-motivated, as there are few usual care or no-treatment conditions. Some of the high maintenance rates may be reflective of new quitters who would stop in any program, or even without one.

This comparison of clinic-based programs and worksite programs assumes that participants in each setting are similar. Although the demographic and smoking history characteristics of subjects in these reports do not appear to differ systematically from other studies in the cessation literature, there may still be marked differences between the groups. For example, since worksite programs generally attract a higher percentage of smokers than do community-based clinics, some of these subjects may be more recalcitrant smokers (Bishop and Fisher 1984). The convenience of the worksite setting may also attract more smokers. On the other hand, it may be that only individuals who have repeatedly failed to quit on their own will expend the time, effort, and money often involved in participating in community clinics (Schachter 1982). To date, the primary determinant of participant characteristics in the controlled outcome studies (Table 2) seems to be the type of worksite in which a program is conducted. Research is needed on the hypotheses concerning possible differences between participants in worksite programs and smokers attending community clinics.

Several differences between studies reporting high success rates and those with less favorable results are clear. One of the more

striking differences to emerge is that the results of the better controlled studies summarized in Table 3 (median posttest cessation rate, 28 to 31 percent) are generally lower than those of the uncontrolled studies outlined in Table 1 (median posttest cessation rate, 60 percent). The most obvious explanation for this finding is that most of the controlled studies included objective biochemical indices of treatment outcome and subjects in these studies may have more accurately reported their smoking status.

The intensity of smoking modification programming also appears to be related to treatment outcome. Programs involving only a brief session or two or relying primarily on self-help materials generally produced the lowest cessation rates—from 4 to 14 percent long-term abstinence (e.g., Li et al. 1984; Nepps 1984). In contrast, the best cessation rate reported came from an intensive multicomponent program involving 20 group meetings over a 7-month period (Stachnik and Stoffelmayr 1983). The only worksite study to directly compare different levels of program intensity found that a greater number of sessions was associated with higher cessation rates (Schlegel et al. 1983).

Another fairly consistent finding is that programs conducted in larger worksites generally seem to produce poorer outcomes. Of the abstinence-based programs, studies taking place in worksites with 100 or fewer employees (e.g., Miller 1981; Shepard 1980; Stachnik and Stoffelmayr 1983) seem to attain the highest abstinence rates, and the larger scale controlled trials (e.g., Kornitzer, Dramaix et al. 1980; Li et al. 1984; Rose et al. 1980) to result in much lower abstinence rates. Bishop and Fisher (1984), who have conducted programs in a variety of different sized worksites, concluded that larger worksites also typically produce lower participation rates than do smaller companies. However, a greater number of employees may still be served.

Programs addressing multiple risk factors (e.g., Rose et al. 1980) in worksite settings generally yielded poorer cessation rates (and tended to be conducted in larger worksites) than did smoking-modification-only programs. Multiple risk factor programs may achieve greater overall reductions in morbidity and mortality because of their effects on other risk factors, however. Finally, programs providing incentives for smoking abstinence (e.g., Shepard 1980; Stachnik and Stoffelmayr 1983) were among those with the more impressive outcomes, although not objectively verified. These findings are discussed in more detail in the section on incentives.

Remaining Issues

Few worksite studies have investigated participant characteristics associated with treatment outcome. The most consistent finding to emerge is that smokers of lower numbers of cigarettes have greater

success at quitting than do heavier smokers (e.g., Kornitzer, Dramaix et al. 1980; Li et al. 1984; Rand et al. 1984). This finding is consistent with results of clinic-based programs (e.g., Ockene et al. 1982) and suggests that special attention needs to be devoted to ways to successfully treat heavy smokers.

Relatively little is known about the long-term effects of the non-abstinence-based smoking reduction programs under review (Tables 2 and 3). Allowing subjects to choose the treatment goal of abstinence or of reduced smoking may attract more participants, provide initial success experiences that can be built upon in later cessation efforts, and benefit those subjects not able to achieve or maintain abstinence. On the other hand, such programs may dissuade subjects from pursuing a goal of complete cessation and allow participants to rationalize that smoking is not hurting them because they have made changes in smoking rate, topography, or cigarette brand. It is beyond the scope of this chapter to review the complex literature on potential compensation effects resulting from changes in smoking behavior (see McMorrow and Fox 1983; Moss and Prue 1982). It should be noted, however, that subjects selecting smoking reduction goals have generally shown reliable, although not always large, reductions in carbon monoxide levels (e.g., Glasgow et al. 1984).

There has been improvement in the research methodology employed in worksite smoking modification studies. The majority of studies conducted in the recent past have included both comparison conditions and biochemical measures of smoking exposure. There are still, however, a number of methodological deficiencies in current worksite studies. Comparison conditions do not usually include no-intervention or usual care groups; differences among interventions are most commonly studied, and randomization is not always used. Little is known about participation rates (only one-third of the studies listed in Table 2 provide information on the percentage of smokers participating). Data are seldom presented on effects of a program on *all* smokers in an organization, and no data have been published on characteristics of employees who participate in worksite programs versus those who do not. Finally, there are so few data on the health benefits or cost effectiveness of specific programs that this information was not included in Table 3. Only the large-scale multiple risk factor reduction trials (Kornitzer, De Backer et al. 1980; Rose et al. 1980) have presented such data.

Special Issues Relevant to Worksite Programs

Social Support

One of the most frequently cited reasons for conducting smoking modification programs in occupational settings is the potential for

invoking peer and environmental support for nonsmoking (Chesney and Feuerstein 1979; Stachnik and Stoffelmayr 1981). It has been argued that peer support has important, long-lasting effects on the outcome of stop-smoking efforts (Janis 1983), and there have been several calls for increased study of the role of social support in smoking modification (Klesges and Glasgow 1985; Lichtenstein 1982; Stachnik and Stoffelmayr 1981). There are also correlational findings that suggest the importance of social support to successful smoking cessation (e.g., Coppotelli and Orleans, in press; Mermelstein et al. 1983).

Given this background, it is surprising that a large-scale correlational study of occupational settings by Caplan and colleagues (1975) found that the degree of perceived support from coworkers was *inversely* related to smoking status. Among workers with low levels of job stress, ex-smokers reported lower levels of support than current smokers. There was no relationship between social support and smoking status for people with high levels of job stress. However, Caplan and colleagues' measure of social support was not specific to smoking cessation, and may have been more an index of the employee's responsibility for supervising or otherwise interacting with other worksite personnel. More recent studies by Malott and colleagues (1984) and by Glasgow and colleagues (in press) have found a complex relationship between social support and outcome of worksite smoking modification programs. Using a measure that produced a score for both supportive and nonsupportive (negative) social interactions, these two studies found that the presence of smoking-related negative social interactions was inversely related to treatment success. The presence of positive social support, which is more frequently the target of social support interventions, was not related to outcome.

Social support procedures such as use of a buddy system and inclusion of nonsmoking coworkers or family members in treatment sessions have been part of a variety of worksite programs (e.g., Bauer 1978; Sorman 1979; Stachnik and Stoffelmayr 1983). Unfortunately, it is impossible to evaluate the contribution of social support in these studies because of the multitude of other intervention strategies also employed. In a review of studies on the effects of worksite incentive programs for smoking cessation, Shepard and Pearlman (in press) concluded that incentive programs that included spouses produced better outcomes than those that did not.

The few worksite smoking studies that have attempted to experimentally manipulate the level of social support have produced discouraging results. Abrams and colleagues (1985) compared a social support/social skills training program including a buddy system with health education and cognitive-behavioral stress management procedures as ways to improve the long-term effectiveness

of a nicotine-fading cessation program. By the end of the program, subjects in the social support/skills condition had relapsed significantly *more* than subjects in the other conditions, and these differences persisted at followup. In addition, consumer satisfaction ratings revealed that subjects liked the social support/skills program less well than other options. Abrams and colleagues concluded on the basis of these findings that factors such as social support, theoretically assumed to enhance treatment, may actually reduce the effectiveness of a treatment program in some instances.

Malott and colleagues (1984) evaluated the effects of adding a coworker support component to a multicomponent treatment program offering subjects the options of abstinence or controlled smoking. They found that the addition of coworker support did not improve treatment outcome on any dependent variable and that subjects found the condition with social support to be less credible than the basic treatment program. A replication and extension of the Malott group's (1984) study by Glasgow and colleagues (in press) involved family or significant-other social support and included a partner-support manual, two group meetings for supportive others, individualization of support procedures, and semiweekly phone calls to partners. The results of this study were consistent with those of Malott and colleagues (1984): no incremental effects of the social support program were obtained from any dependent variable.

Thus, in research conducted to date, the inclusion of existing social support procedures has not been found to enhance outcome in worksite smoking modification programs. This is not to say that social support is not important to treatment success, but that the issue is more complex than was initially believed. It may prove difficult to alter existing levels of social support, and novel ways of enhancing coworker and family support for smoking modification need to be developed.

Physician Advice

Because as many as 70 percent of adults in our country visit their physician at least once in a given year (US DHEW 1979), there has been growing interest in finding ways in which physicians can convince patients to give up smoking (Ewart et al. 1983; Russell et al. 1979).

Some of the best data come from recent European clinical trials (Rose et al. 1980, 1982; Kornitzer, Dramaix et al. 1980). The Belgian Heart Disease Prevention project (Kornitzer, Dramaix et al. 1980) found that significantly more individuals at high risk for developing heart disease stopped smoking in an intervention condition emphasizing semiannual physician messages than in a screening-only control condition (see Table 3). When comparing a representative sample of all intervention subjects (many of whom did not receive

the physician messages) with a similar sample of control subjects, however, almost identical and fairly low cessation rates were observed in both conditions.

The most intensive worksite physician-intervention program was evaluated in a similar study conducted by Rose and colleagues (1980). In this study, the 12 to 15 percent of subjects in the intervention condition who were at greatest risk for cardiovascular disease were provided four physician consultations, each approximately 15 minutes in length. Results were similar to the Belgian study in that a greater percentage of the high risk subjects stopped smoking in the intervention group than in the control condition (see Table 3). But considering all participants (many of whom did not receive the intensive physician messages), there were no significant differences between conditions.

A series of four physician visits was also utilized in a carefully controlled study by Rose and Hamilton (1978) of British civil servants at high risk of cardiorespiratory disease. Although not actually conducted in occupational settings (and therefore not included in Tables 2 and 3), subjects for the study were recruited through their worksite. This study produced the highest cessation rates of any physician-advice study (self-reported abstinence rates of 51 and 36 percent at 1 and 3 years, respectively). Over a third of these subjects were still smoking pipes and cigars, however, and a relatively high percentage of "normal care" subjects also stopped smoking (10 and 14 percent at 1 and 3 years, respectively). Although there were differences in favor of the intervention condition in rate of decline in airway obstruction and rates of phlegm production, there were no differences between conditions in absenteeism over a 1-year period or in overall mortality over a 7- to 10-year period.

As these studies indicate, there are both advantages and disadvantages in using physician stop-smoking messages in worksite settings. One distinct advantage is that if stop-smoking advice is incorporated into regularly scheduled physician visits, a relatively large number of workers can be advised and treated quickly and cost effectively (Lichtenstein and Danaher 1978). Another advantage of the physician model is that it is relatively unobtrusive in comparison with management-sponsored programs (Danaher 1980). Physician advice can also be used to augment other interventions rather than to replace them, by assisting workers in deciding to seek help and by promoting participation in intervention programs, therefore facilitating better use of these programs.

Although self-reported cessation rates resulting from physician advice are low in an absolute sense, research is underway to attempt to increase the impact of stop-smoking messages. Li and colleagues (1984), in a study conducted in a navy shipyard clinic, found that implementation of a 3- to 5-minute session of behavioral counseling

by staff physicians significantly increased cessation rates over those resulting from a simple warning to quit smoking (see Table 3). In addition, the compliance of health care providers with treatment protocols also affects outcome. For example, Li and colleagues (1984) reported great difficulty in getting clinic physicians to consistently deliver a brief 3- to 5-minute message to patients, yet Ewart and colleagues (1983) found that providing physicians with regular performance feedback appears to improve the quality and quantity of stop-smoking messages. Future research should identify procedures to improve both the implementation and the outcome of physician stop-smoking advice. Perhaps a stop-smoking message in conjunction with other interventions may increase success rates.

Basic research on the effects of threatening communications such as those describing health risks of smoking indicates that such messages have their greatest impact if individuals know not only what to do (e.g., stop smoking) but how to do it, and believe themselves capable of acting (Leventhal 1970). The recent approval of nicotine chewing gum by the U.S. Food and Drug Administration and the availability of high quality self-help stop-smoking manuals (e.g., Davis et al. 1984) now present an opportunity for physicians to deliver a health warning accompanied by concrete recommendations for what to do and how to do it. Recent data suggest that nicotine chewing gum may assist heavier or more addicted smokers in quitting (Fagerstrom 1978, 1984; Raw et al. 1980), and gum prescriptions can be written at the same time that a stop-smoking message is given. Only one study reviewed in this chapter has investigated the use of nicotine gum (Schlegel et al. 1983). That study, which did not involve physician advice, found that the gum enhanced treatment outcome in self-help conditions, but in the context of an intensive 17-session treatment program, subjects receiving the gum actually had lower cessation rates than subjects not receiving gum. Particularly in companies that employ their own medical staff or in which employees are at risk because of occupational hazards, programs combining physician stop-smoking advice with other intervention options should be evaluated.

Incentives

Recently there has been increased interest in the motivational factors associated with smoking behaviors (Shepard and Pearlman, in press; Brownell 1985). This section focuses on two recent approaches to increasing motivation: personal incentives and competition among participants.

Rosen and Lichtenstein (1977) published the first report on the effects of an employee incentive program for stopping smoking. Of the employees of a small ambulance company who smoked, 75 elected to participate in a program that involved a $5 per month

bonus for not smoking at work—for all employees regardless of their initial smoking status. At the end of the year, the owner also matched the total amount of bonuses received during the program. No other intervention techniques were used, and no stop-smoking meetings were held. This study underscores the potential power of incentives to modify smoking behavior: at posttest, 58 percent of the pretest smokers reported no longer smoking at work.

Sorman (1979) reported on a program that combined personal incentives, a stop-smoking program, social support, low-calorie food alternatives, and an exercise program. Of 202 employees, 55 enrolled in the program in which each employee who quit smoking for 1 year received a $200 reward. Thirty-one percent of the participants reported having successfully stopped smoking for the entire year. Shepard (1980) presented results from an ongoing incentive program involving weekly $7 paycheck bonuses to employees not smoking at work. After approximately 4 years, only 20 percent of the employees reported smoking in the worksite compared with 67 percent at pretest.

Stitzer and Bigelow (1982, 1983, in press) have conducted a variety of studies that cogently demonstrate that contingent reinforcement for reductions in carbon monoxide (CO) levels of expired breath samples can produce reliable short-term reductions in CO levels in hired cigarette smokers. A recent study (Rand et al. 1984) investigated contingent reinforcement for smoking *abstinence* in 18 hospital employees. After 1 week of baseline smoking and a week-long "cutdown test," subjects could earn $12 a day for 2 weeks if they totally abstained from smoking and if their daily CO readings were consistent with abstinence (<11 ppm). Sixty-one percent of the participants were abstinent throughout the 2-week contingency period, and 28 percent remained abstinent throughout a 3-week followup.

Finally, Stachnik and Stoffelmayr (1983) evaluated a comprehensive 7-month-long worksite program involving sizable financial incentives as well as health information, social support, and public commitment to nonsmoking in the context of 20 gradually paced group meetings. The program was conducted in three different worksites, with from 47 to 70 percent of smokers enrolling in the program and an astounding 80 to 91 percent of participants reporting abstinence 6 months after participation in the program. These results are obviously very impressive, but it is not possible to evaluate the contribution of incentives versus the other procedures employed.

Shepard and Pearlman (in press) recently reviewed 15 (mostly unpublished) programs that used incentives to produce changes in smoking behavior in the worksite. Some programs provide incentives for not smoking at the worksite, and others have a goal of total

abstinence. Although incentive programs seem to be gaining in popularity and self-reported cessation rates appear high, there are a number of problems with evaluations of incentive-based smoking programs. Most studies are uncontrolled, and with notable exceptions (e.g., Rand et al. 1984), measures of smoking status during nonwork hours and biochemical verification of smoking status are lacking. Clearly, incentive programs deserve further investigation, because they appear to be effective, relatively inexpensive, and easy to implement in a variety of different settings.

Another approach to providing incentives for improvements in health-related behaviors is to arrange competitions among different worksites or teams within a given worksite. For example, Brownell and colleagues (in press) report high participation rates, low attrition rates, and impressive outcome data in a recent worksite obesity competition. Given these promising results, Klesges and colleagues (1985) conducted a worksite smoking competition among four banks. Prizes to benefit both smokers and nonsmokers were awarded to the bank with (1) the highest participation rate, (2) the largest reductions in carbon monoxide levels at posttest, and (3) the greatest abstinence rate at the 6-month followup. All participants in this study received a gradually paced smoking control program previously used in worksite settings (Glasgow et al. 1984). Finally, a "Smoking Barometer" placed in the lobby or lounge of each worksite provided employees with weekly feedback on how their bank was doing compared with the other three.

Participation rates in the program were exceptionally high. Overall, 88 percent of all bank employees who were smokers entered the program, compared with a 53 percent participation rate at a comparable savings and loan organization that received the identical program without competition, a significant between-groups difference. There were, however, no differences between conditions in cessation rates among participants in the program. This may have been because subjects in the competition condition were more nicotine dependent, as assessed by the Fagerstrom (1978) Tolerance scale, than subjects in the noncompetition condition ($p < 0.02$). Because of the higher participation rate, however, the competition condition produced a higher long-term cessation rate (15 percent) throughout the worksite than the comparison condition (7 percent).

One of the major advantages of incentive and competition programs is that they do not require large amounts of therapist or participant time. If the success rates of the uncontrolled studies (Table 1) can be replicated in controlled studies, incentive programs may prove to be the most cost-effective approach to worksite smoking modification. On the other hand, at least some people may require additional guidance and support (Danaher 1980). One convenient, low-cost method of providing skills training in the

context of incentive programs is through provision of self-help stop-smoking materials (Glasgow and Rosen 1978; Windsor and Bartlett 1984). Although a number of worksite studies have employed written self-help materials as part of multicomponent interventions (Li et al. 1984; Kornitzer, Dramaix et al. 1980; Nepps 1984; Rose et al. 1980), self-help manuals have not been used in incentive programs for smoking cessation and studies to investigate their unique contribution to treatment outcome have not been conducted.

Overall, the results of incentive- and competition-based programs are very promising. However, almost all of these studies have been conducted in small worksites, and systematic replications of these findings in controlled investigations in larger companies are needed. Future research should also investigate the types of personal incentives (e.g., paycheck bonuses versus lotteries for quitters) and competitions (e.g., within a worksite versus between worksites) that work best in different organizations. Finally, nonsmokers should be carefully considered in incentive programs—in their role as supporters of quitters and as nonsmokers, with bonuses for all nonsmokers, old and new—and worksite resources should be provided for all employees.

High Risk Populations

With the exception of the few large-scale clinical trials listed in Table 2 (e.g., Kornitzer, Dramaix et al. 1980, Li et al. 1984; Rose et al. 1980; Schlegel et al. 1983), the majority of participants in worksite smoking programs have been young, from middle or upper socioeconomic levels, and in occupations that do not place them at increased health risk. Although smoking cessation efforts should continue with such populations, an argument can be made for focusing efforts on individuals at particularly high risk for cancer, cardiovascular disease, or respiratory disease—the major causes of excess morbidity and mortality due to cigarette smoking. Given limited resources, it should be more cost effective to direct interventions primarily toward those most likely to develop disease. Three overlapping approaches have been used to reach the following types of high risk smokers in the worksite: blue-collar male workers, workers at risk because of occupational hazards, and individuals predisposed to disease for reasons in addition to smoking (e.g., obesity, hypertension, abnormal lipid levels).

Few worksite programs have been offered by companies employing primarily male blue-collar workers, even though such groups have higher than average smoking rates. Although there is little or no documentation of the reasons for this inconsistency, it may be due to mistaken beliefs among health professionals that such individuals would be less likely to participate in or follow through with a smoking modification program. Ellis (1980) found that blue-collar

workers may be at least as interested in quitting as others in the general population. Resistance on the part of some labor unions may constitute another reason for fewer programs conducted in blue-collar worksites.

Initial worksite smoking research with blue-collar workers has been conducted both at military bases and in Veterans' Administration (VA) hospitals. Schlegel and colleagues (1983) offered programs at 28 different military bases across Canada. Although their outcome results were comparable with other studies, they did report relatively low followthrough (compliance) rates with homework assignments. Also, they must have failed to recruit a high percentage of smokers, because an average of fewer than 10 smokers per base participated. Perhaps a different intervention approach is needed for blue-collar populations—one that does not require employees to devote much time and effort, and one that tailors materials and tasks to be appropriate socioculturally. Dawley and colleagues (1980, 1984) conducted research with employees and patients in VA hospitals and have advocated increased smoking modification efforts within the VA system. They point out that it is ironic that for many years the Nation's largest health care provider sold cigarettes at cutrate prices, owing to tax-exempt status.

Little systematic research with smokers in jobs that place them at risk because of occupational hazards has been reported. For example, asbestos workers are at high risk for respiratory disease, and asbestos workers who smoke increase their risk synergistically (US PHS 1977; see the chapter on asbestos in this Report). Ellis (1980) informally reported on the results of a program for former employees of an asbestos company that involved incorporating antismoking advice into regularly scheduled appointments with company physicians, pairing written self-help materials with feedback on physical status, and offering individual smoking cessation counseling. Over a 4-year period, this relatively low cost intervention was associated with a 30 percent reduction in the proportion of employees who reported being smokers. A related publication by Ellis (1979) provides suggestions for recruiting and treating asbestos workers.

The most extensive no-smoking program involving high risk occupations has been been conducted by the Johns-Manville asbestos company. In addition to a smoking ban throughout the worksite and a company policy of no longer hiring new employees who smoke (Cooper 1978), Johns-Manville launched an intensive antismoking campaign at 14 company sites. This program involved an educational campaign coordinated with SmokEnders cessation clinics and the institution of the companywide smoking ban. Although systematic, published reports of this program could not be located, Orleans and Shipley (1982) reported participation rates of 15 to 20 percent in the cessation clinics and an approximately 75 percent posttreatment

quit rate among participants (apparently without biochemical validation). In the only controlled study to date of worksite intervention in high risk occupations, Li and colleagues (1984) recently studied the effects of physician stop-smoking advice on asbestos-exposed naval shipyard workers. They found, somewhat surprisingly, that subjects who had abnormal pulmonary function tests did not have higher cessation rates (4 percent prolonged abstinence) than workers with normal pulmonary function tests (6 percent prolonged abstinence) who received the same intervention.

The third approach to reaching high risk participants has been to conduct comprehensive health screenings to identify *individuals* at risk for the development of chronic disease. Rose and colleagues (1980) assigned people at high risk of developing heart disease who worked in 24 large industrial companies to intervention or screening-only control conditions. High risk people in the intervention condition were more successful at quitting smoking (12 percent cessation at 5 years) than similar subjects in the control condition (0 percent cessation rate). Similar results were reported by Kornitzer and Dramaix and colleagues (1980) in a parallel large-scale trial conducted in Belgium (see Table 3).

In summary, some promising initial studies have been conducted with high risk individuals. But such studies are few in number and much more intensive study of ways to best reach high risk individuals is needed.

Multiple Risk Factor Reduction Programs

A number of organizations have offered smoking cessation programs as part of employee wellness or lifestyle-modification programs. Such programs typically focus on achieving modifications in several risk factors in addition to cigarette smoking, such as obesity, elevated cholesterol levels, hypertension, and a sedentary lifestyle. Some programs also include components on stress management and modifying Type A behavior. Almost all programs include an initial health screening to identify risk factors, but subsequently there is a considerable divergence in approaches. Some programs focus solely on high risk participants (e.g., Meyer and Henderson 1974; Ware and Block 1982); others invite all employees to participate regardless of risk status (e.g., Naditch 1984). There is also considerable variation in how smoking programs are implemented, with some programs holding separate meetings for smokers and others including information on smoking modification as part of their general wellness program.

The concept of providing smoking modification services as part of a more general lifestyle program is appealing. Stopping smoking can be seen as one aspect of adopting a more healthy lifestyle, and other program components such as increased levels of exercise may